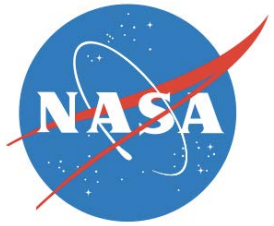
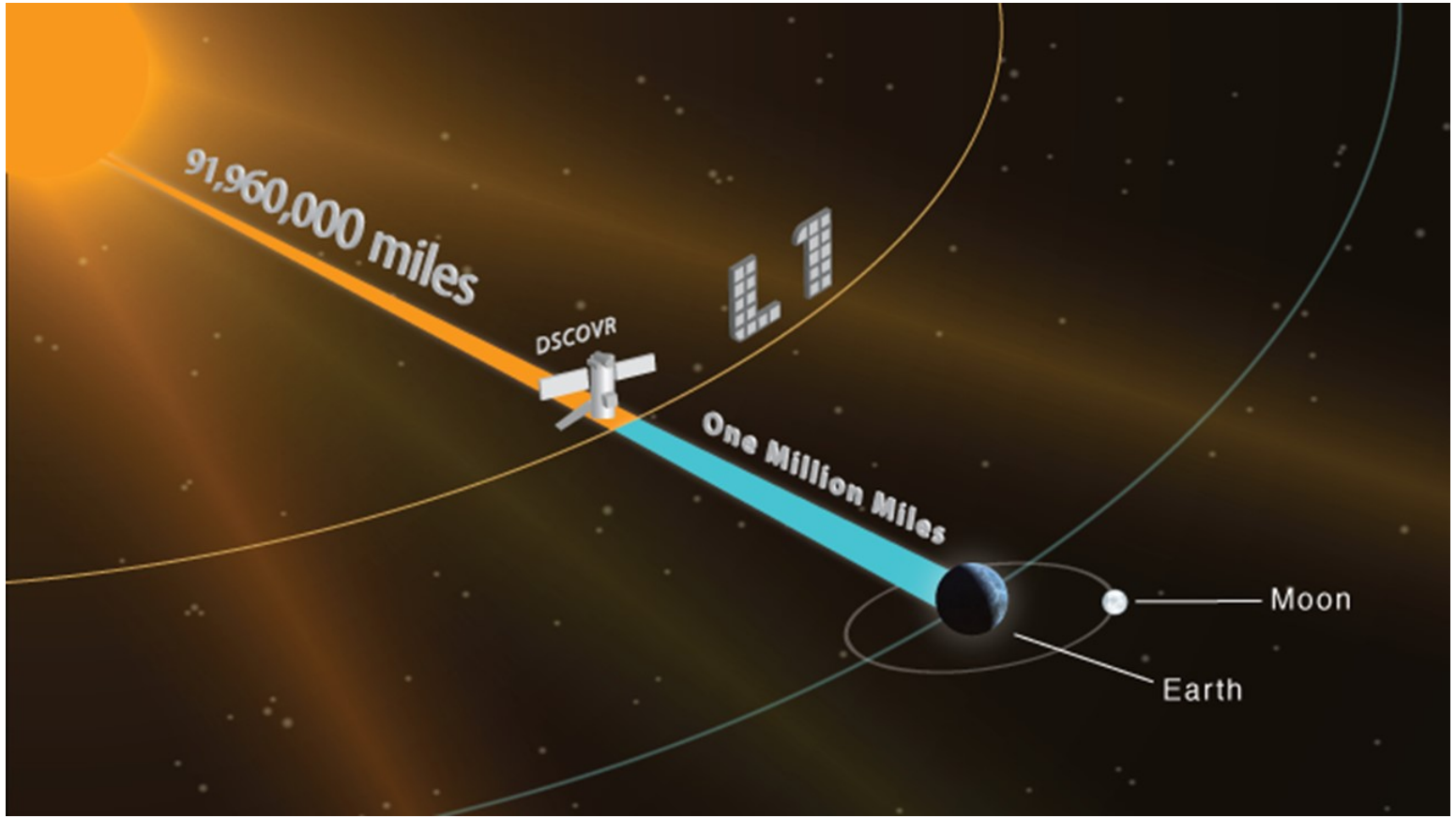


Deep space observations of sun glint over oceans

Tamás Várnai[1,2], Alexander Marshak[1], Alexander Kostinski[3]

1: NASA GSFC, 2: UMBC JCET, 3: Michigan Technological University

The DSCOVR spacecraft is at the L1 Lagrangian point



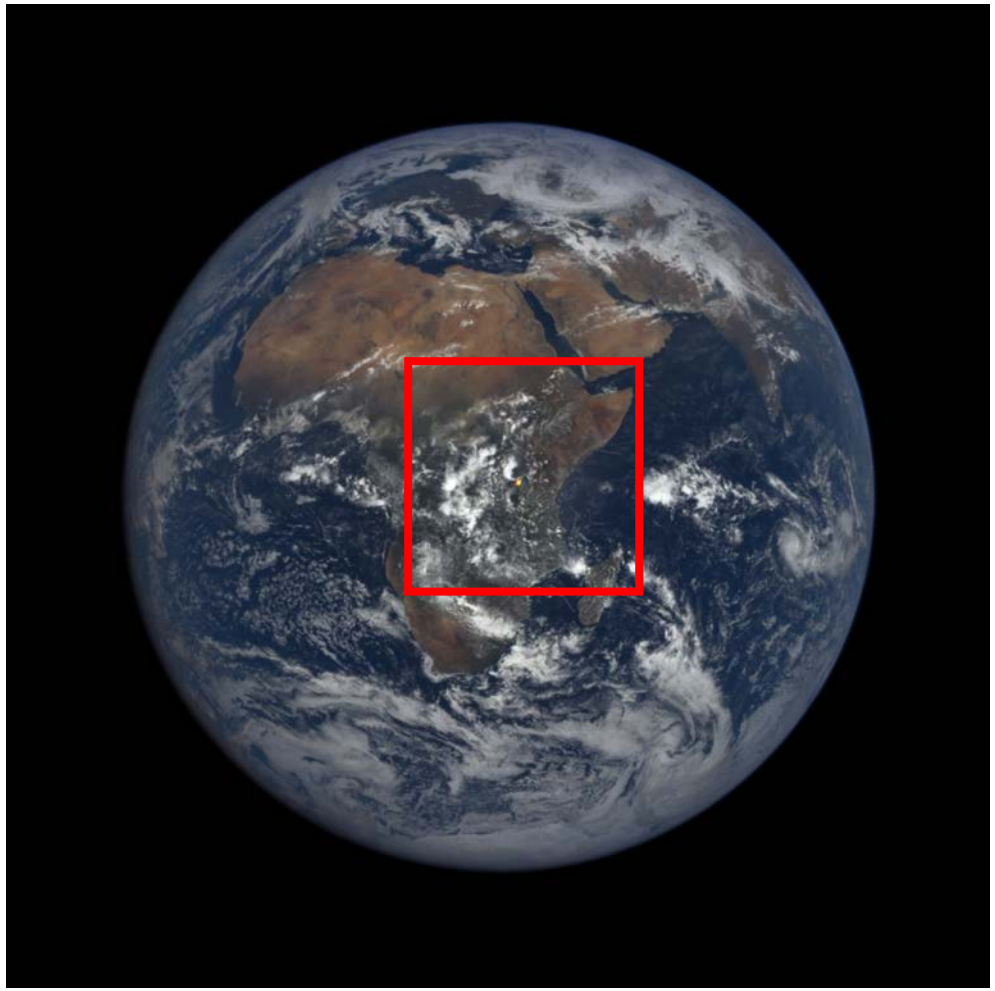
View from DSCOVR by the EPIC camera

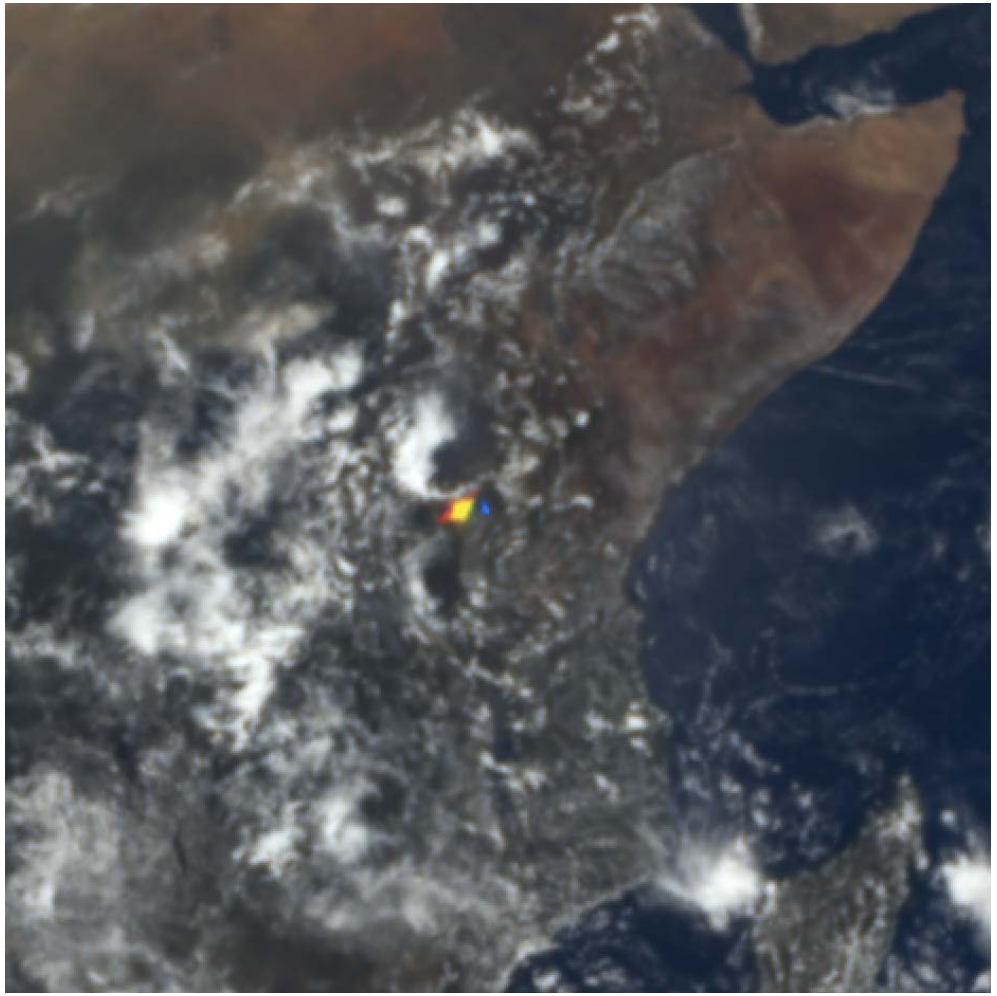
2016 03 23

2016 05 29

EPIC: Earth Polychromatic Imaging Camera

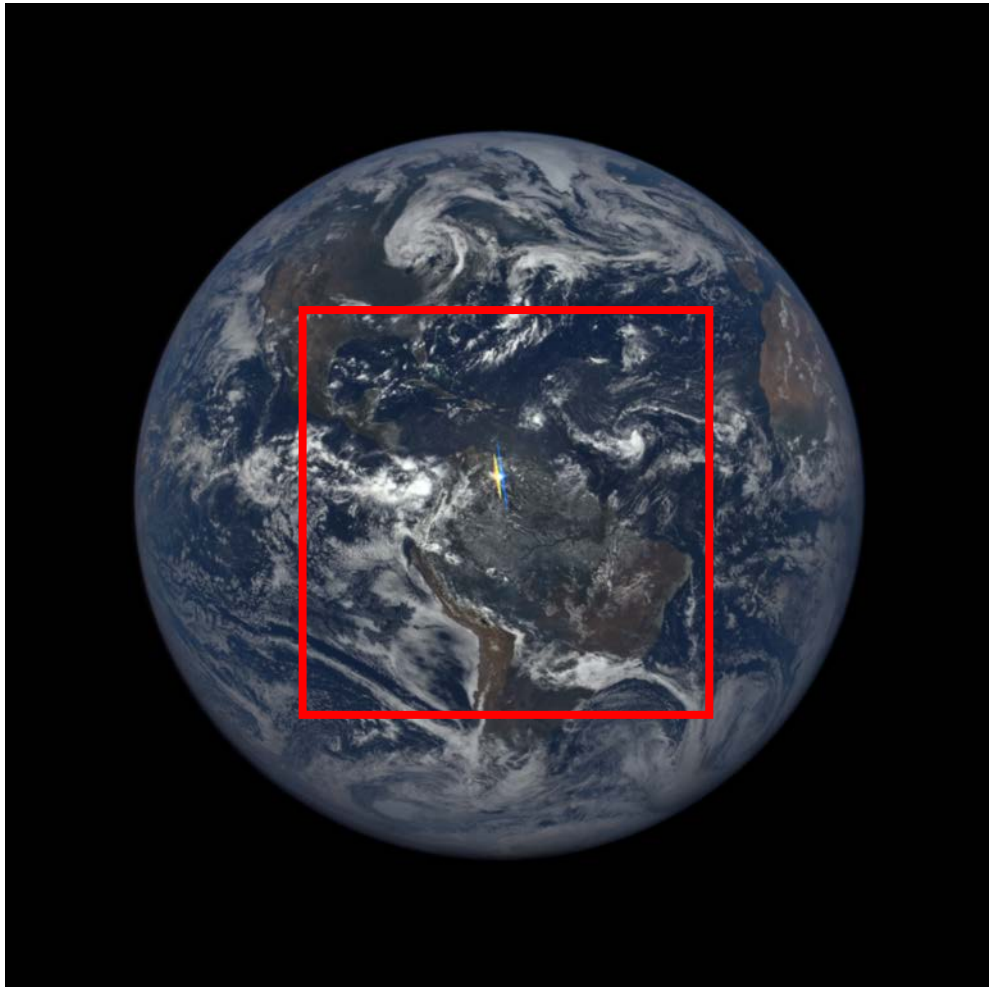
Colorful bright spot over Africa

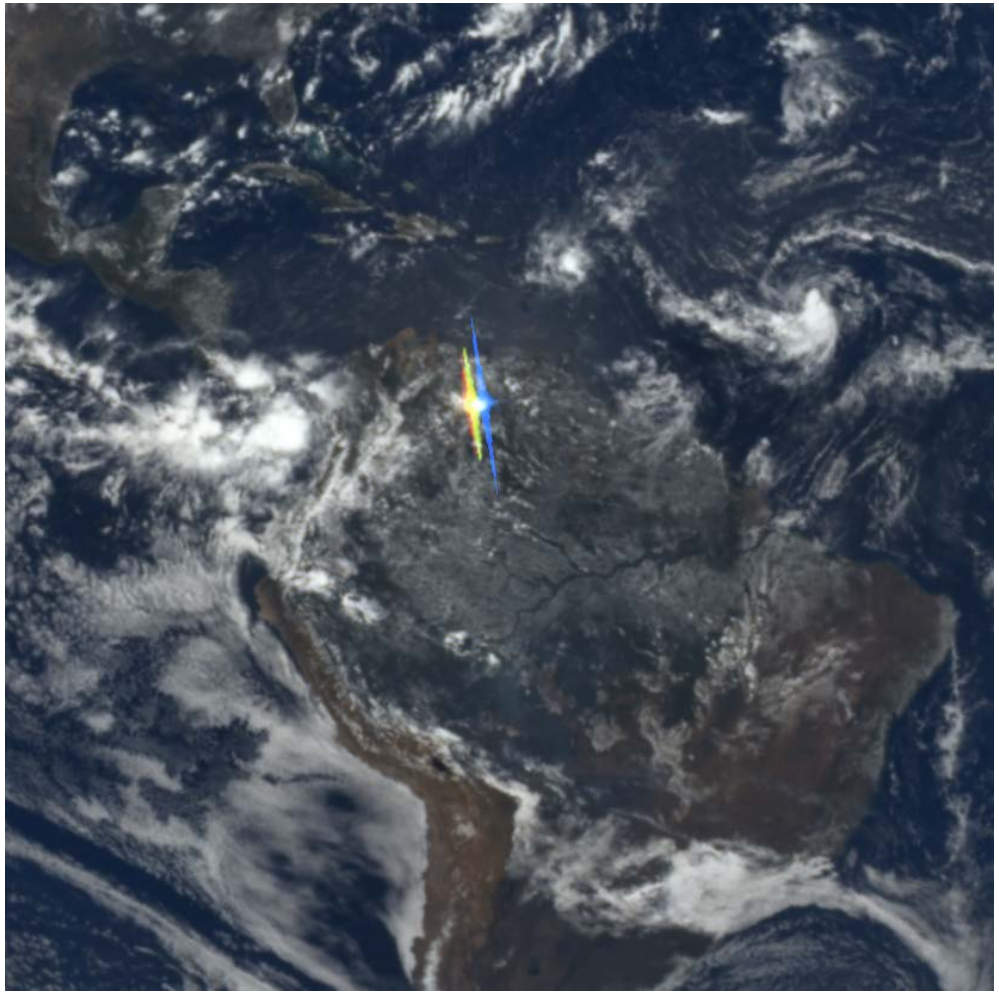




2016 03 17, 09:46 UTC

Colorful bright spot over South America

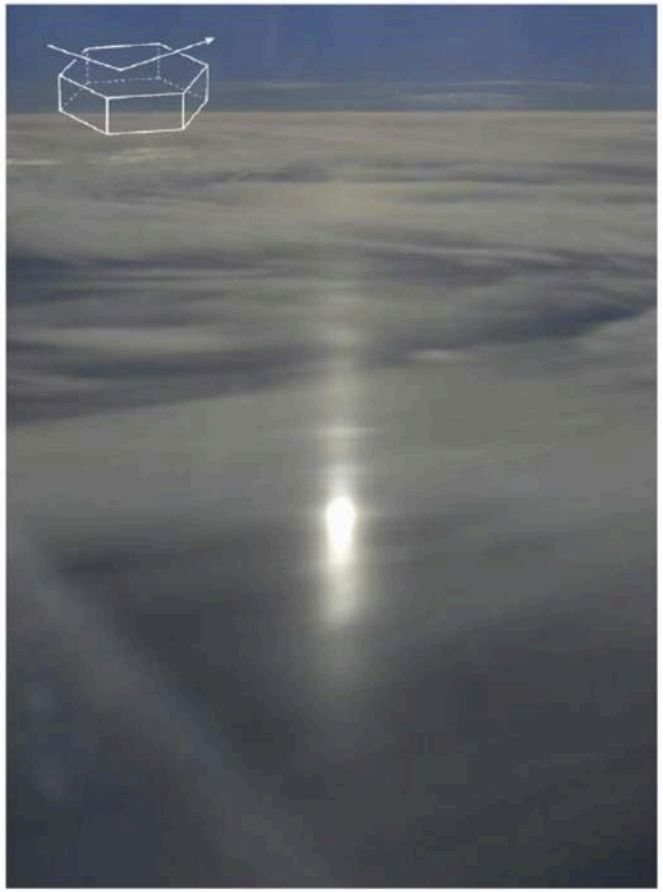




2015 08 24, 16:35 UTC

Glint form horizontal ice crystals in clouds (subsun)

Photo from aircraft

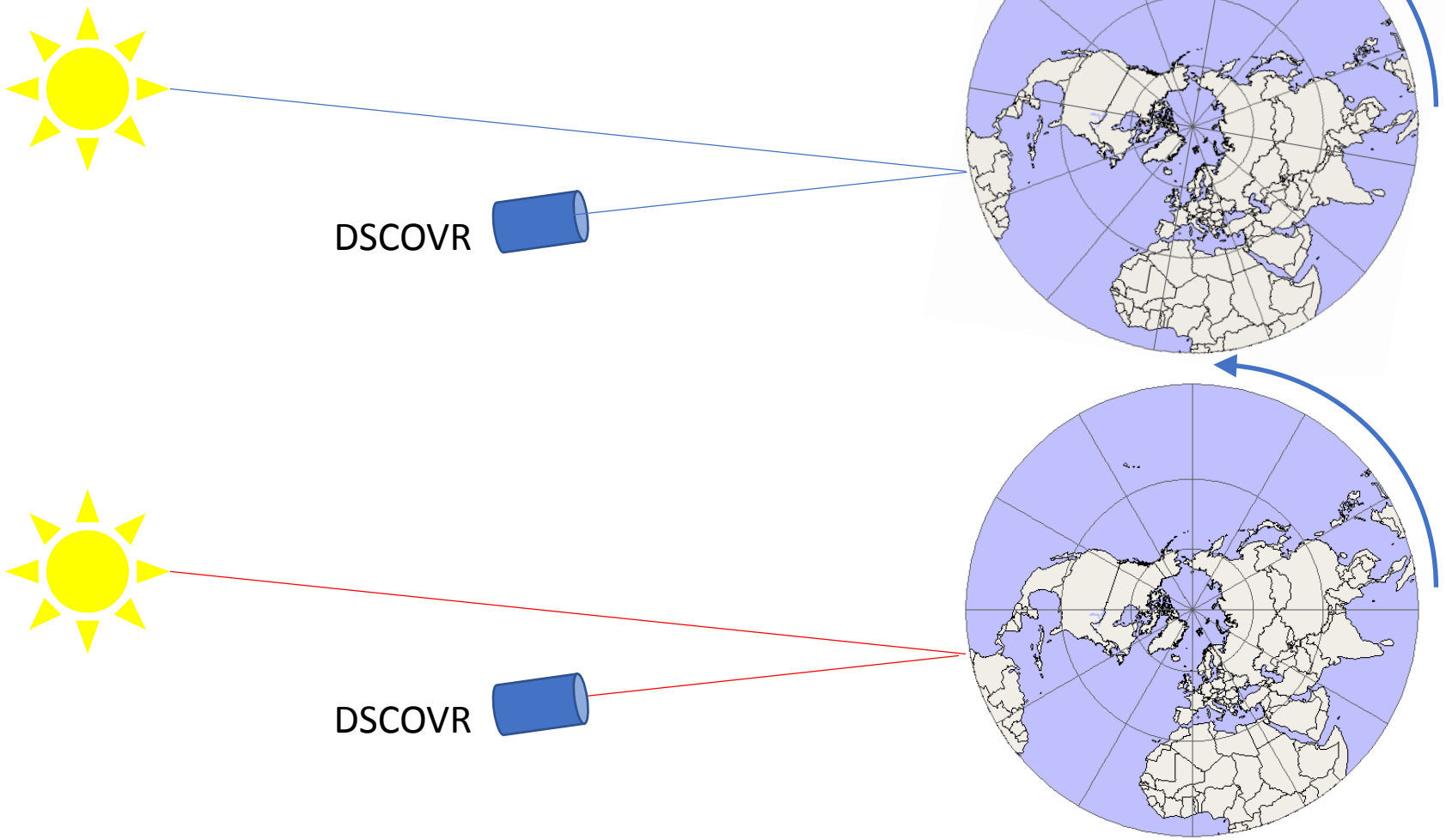


Können (2017, BAMS)

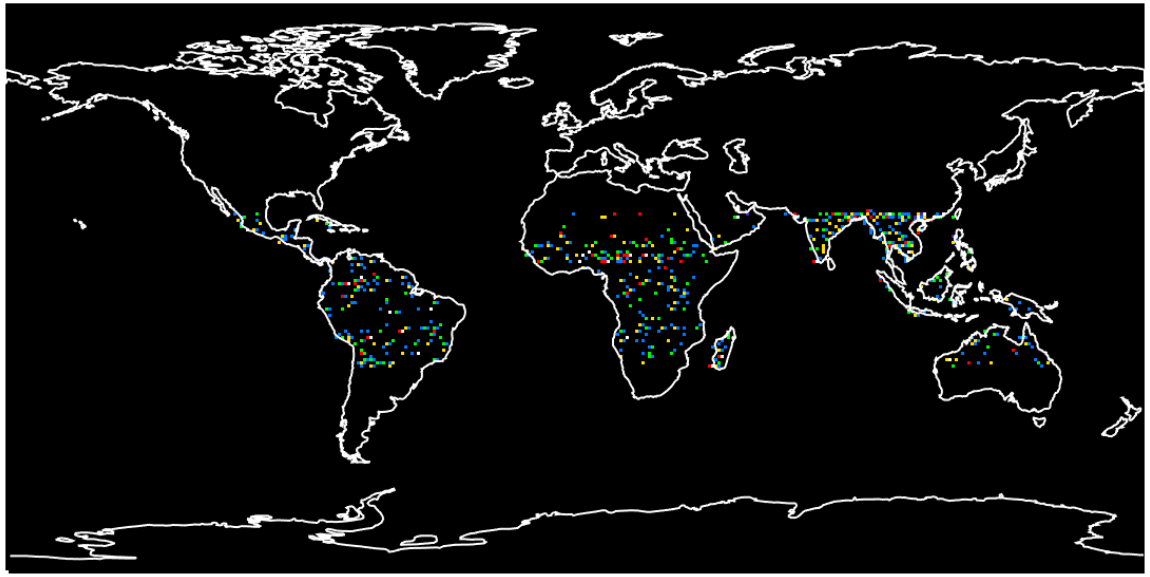
Glints appear colorful, as the Earth turns between blue & red images

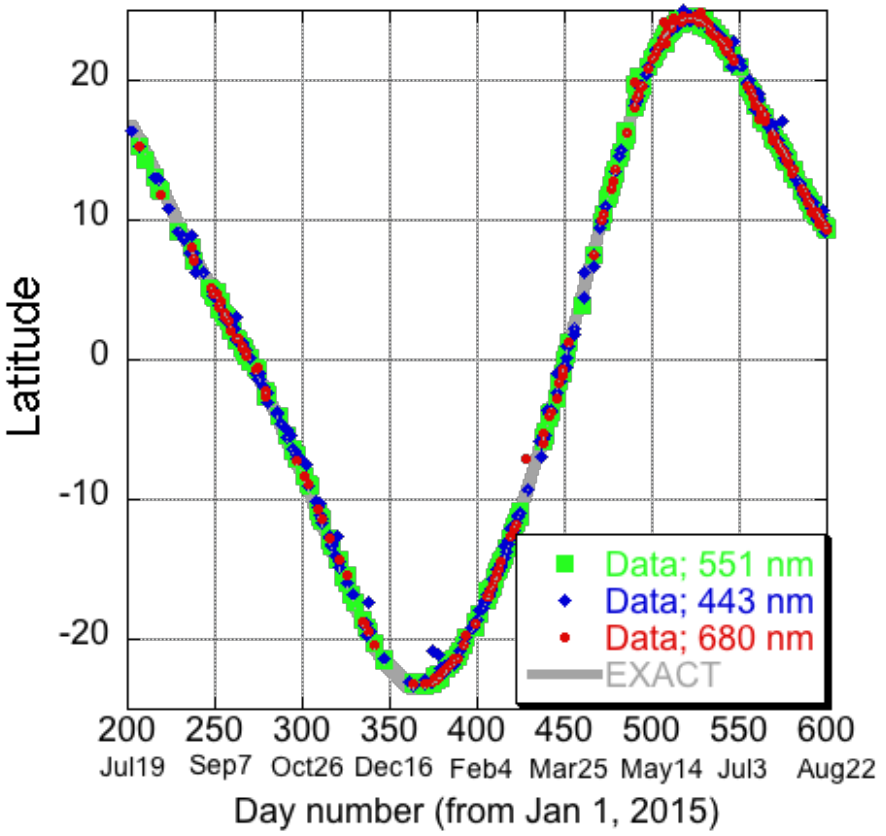
Time of blue image

Time of red image
(≈4 minutes later)
Glint shifts by ≈ 100 km



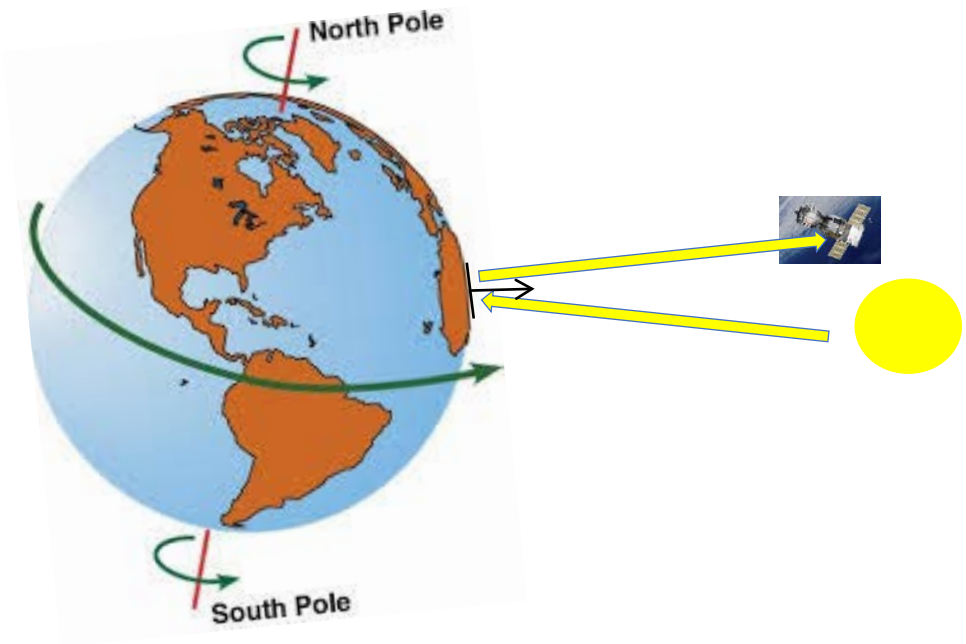
Location of glints observed over land during a year



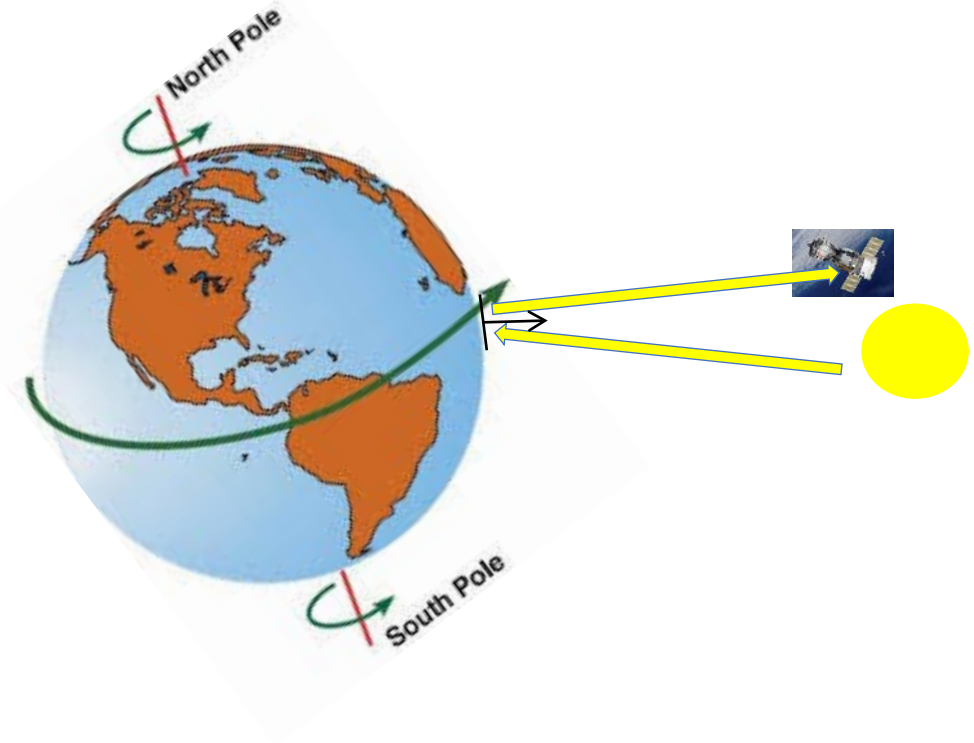


Latitude of expected glints varies through the year

Northern summer

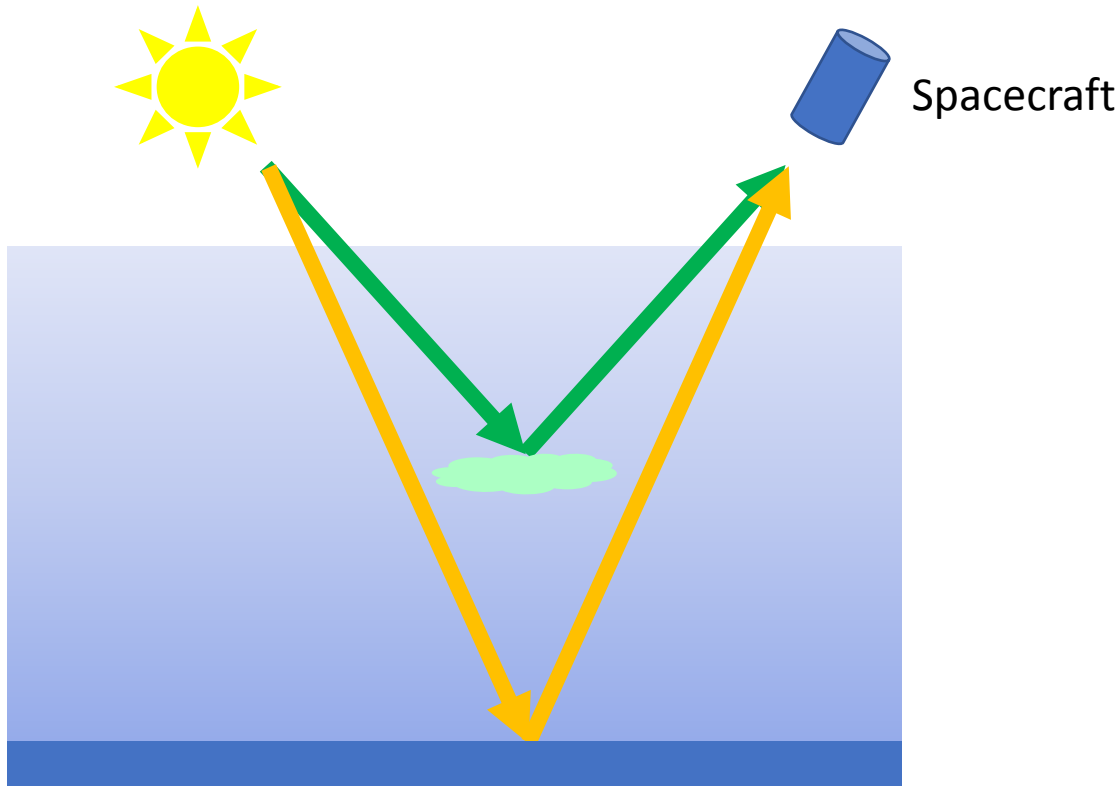


Northern winter



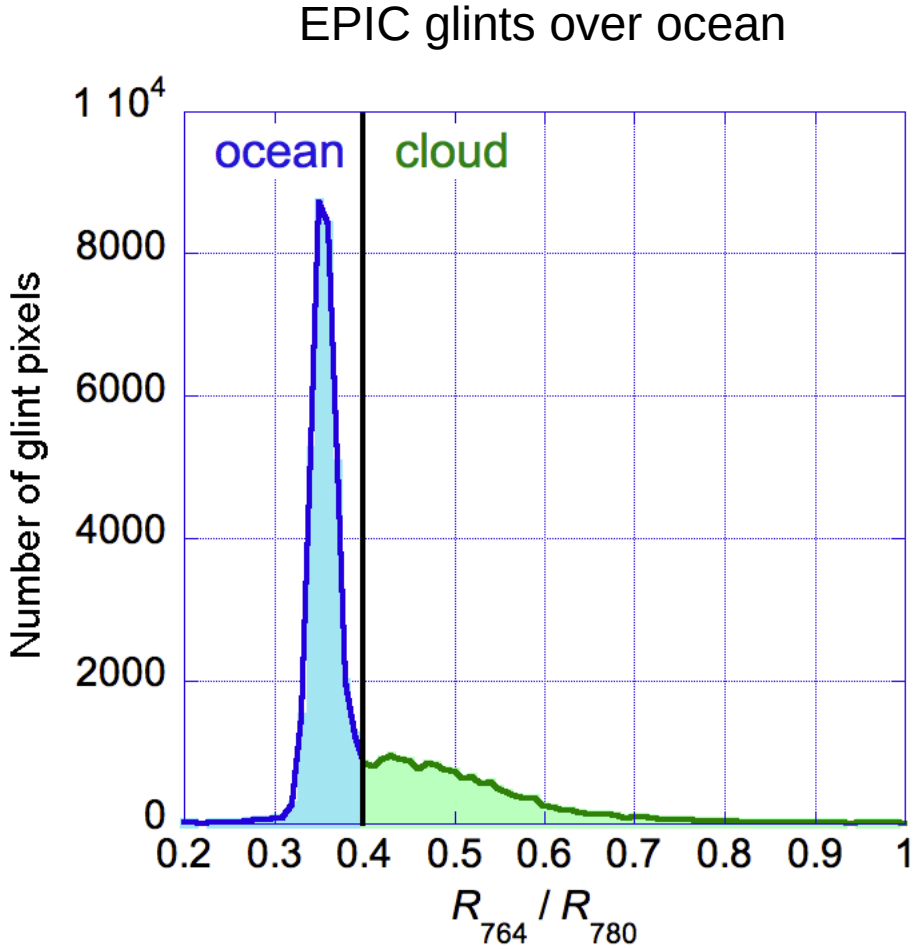
Oxygen absorption bands can reveal altitude of glints

$$\textit{Ratio} = I_{abs} / I_{non\text{-}abs}$$



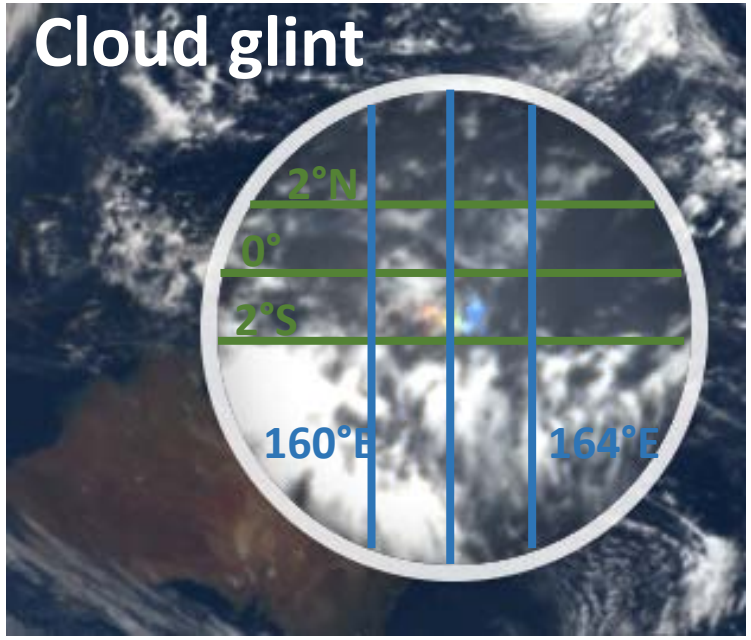
Surface reflection:
Low reflectance ratio

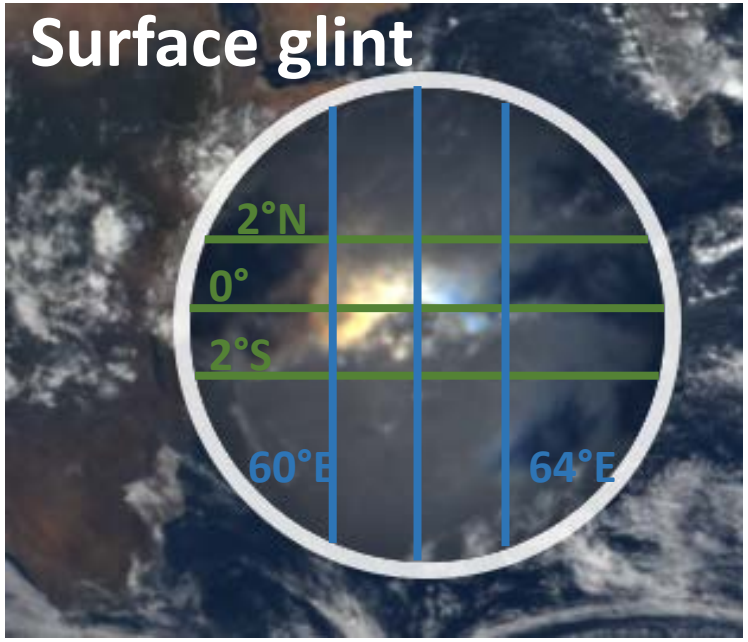
High cloud reflection:
High reflectance ratio



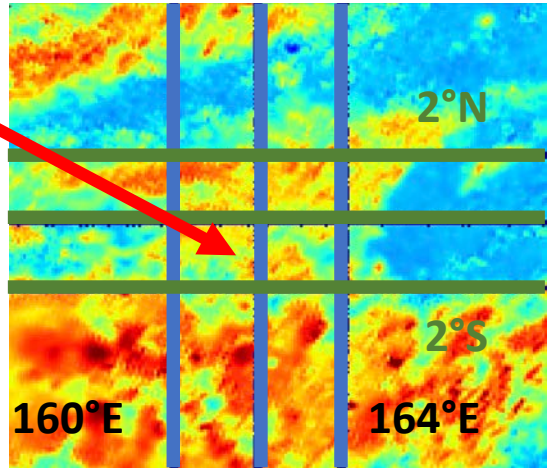
1 year long dataset

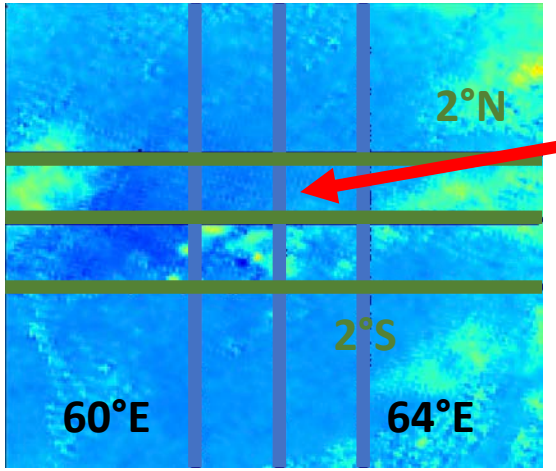
Comparison of a cloud glint and a surface glint



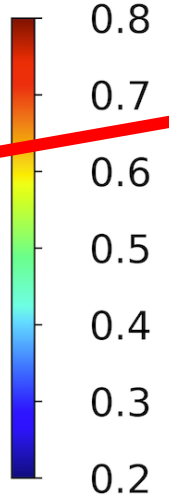


small ratio





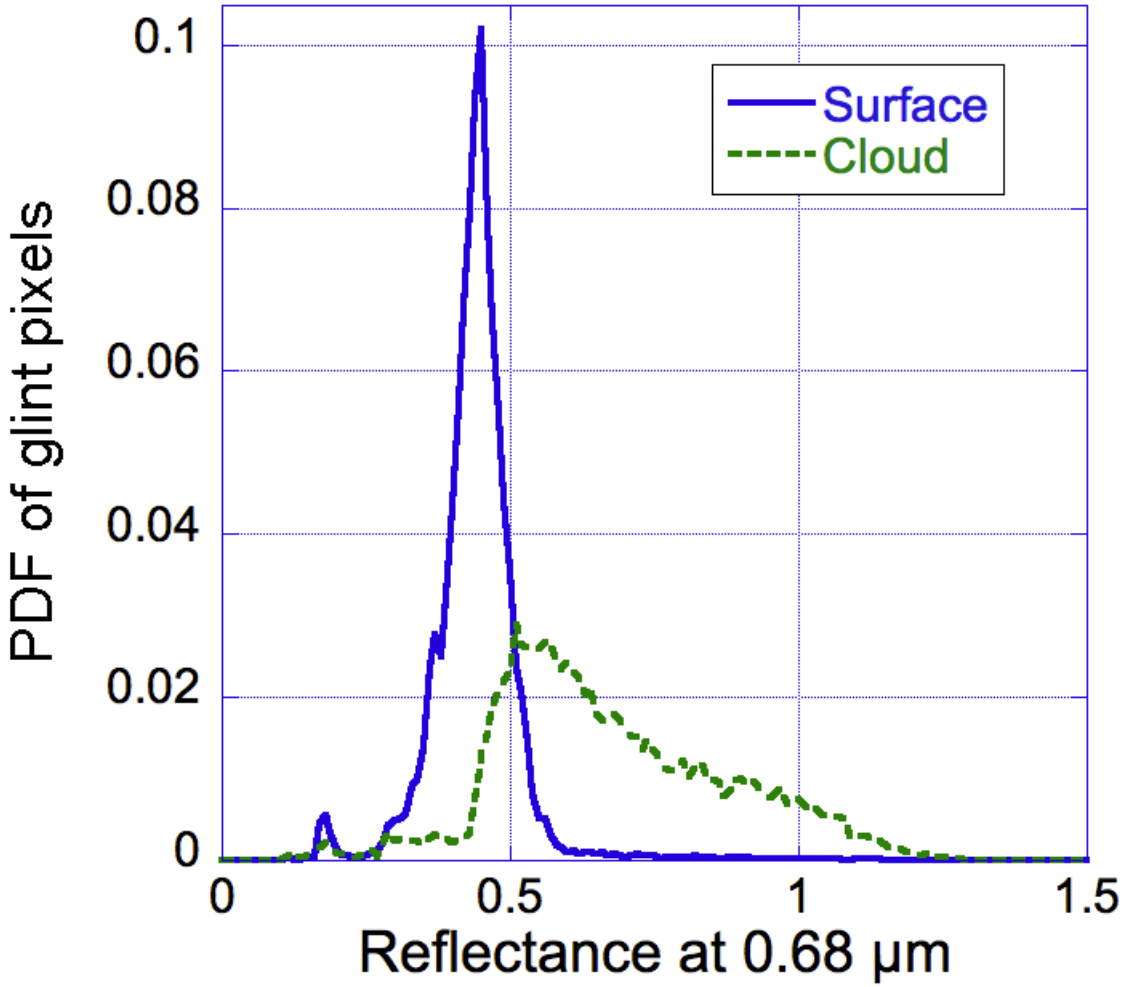
large ratio

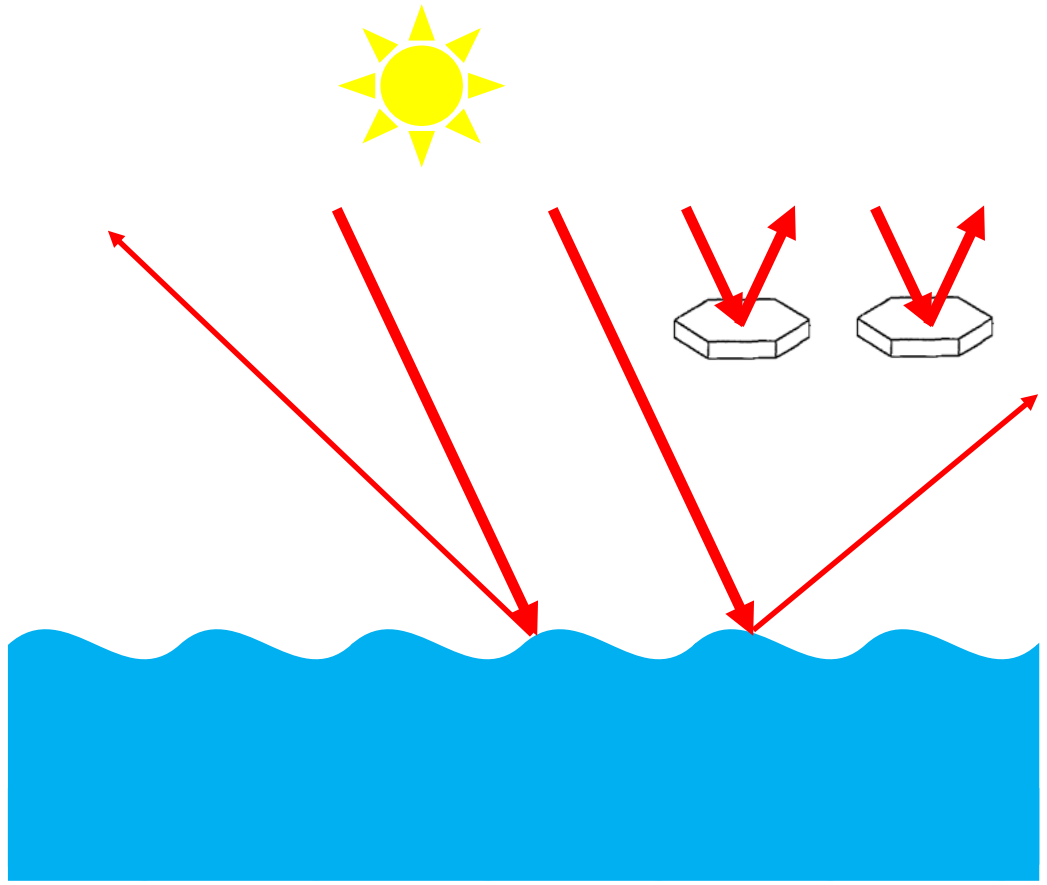


R_{764} / R_{780}

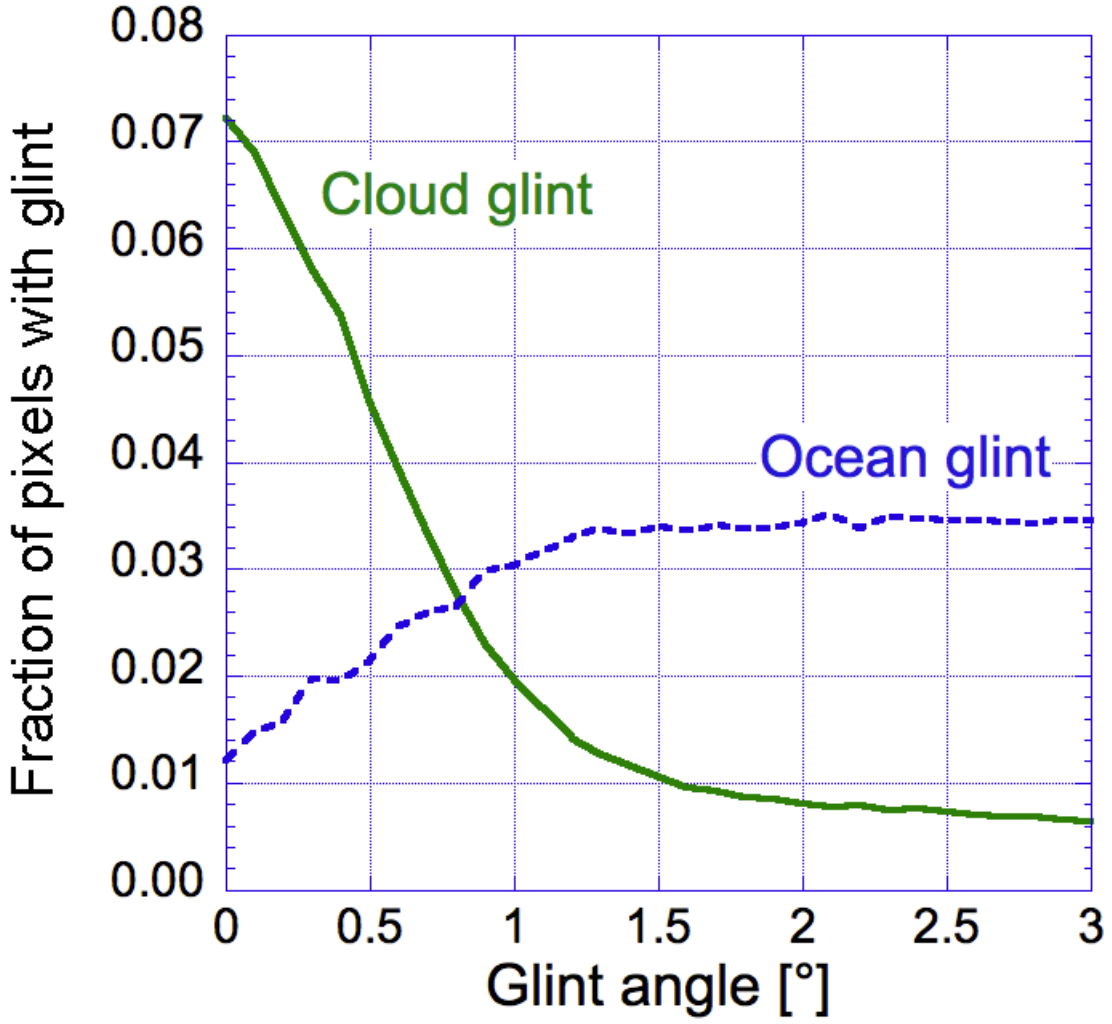
Oct. 3, 2015

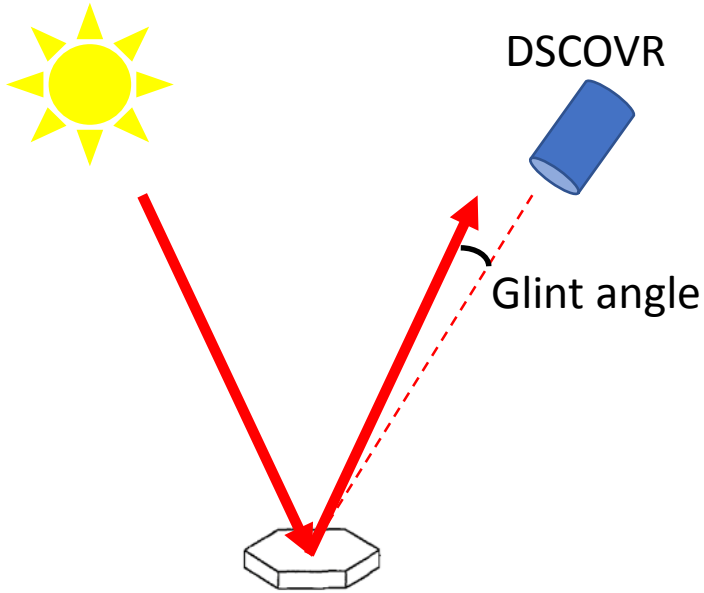
Red glints are brighter from clouds than from ocean





Cloud glints are narrow and fairly frequent in ice clouds





- At potentially ideal glint locations over ocean, cloud glint is detected for 6% of EPIC pixels
- MODIS ice cloud fraction: 22%
- Glint is detected in roughly ¼ of ice clouds

Summary

- Many DSCOVR/EPIC images contain colorful bright spots over land and ocean.
- Analysis of sun-view geometry and O_2 absorption bands demonstrate that these spots are caused by specular reflection from water surfaces and from horizontally oriented ice platelets floating in clouds.
- Over ocean, cloud glints are detected in roughly 6% of pixels or 1/4 of ice clouds at the locations where EPIC can observe specular reflection.
- Such observations can help to constrain the likelihood of oriented ice crystals and their contribution to Earth's albedo.
- Glint observations may even help in characterizing exoplanets.

Marshak, A., T. Várnai, and A. Kostinski (2017), Terrestrial glint seen from deep space: Oriented ice crystals detected from the Lagrangian point, *Geophys. Res. Lett*., **44**, doi:10.1002/ 2017GL073248.